

**EFFECT OF SOME ENVIRONMENTAL FACTORS
ON IMMUNITY MEASUREMENTS AND THEIR
GENE EXPRESSION IN RABBITS**

By

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B.Sc. Agric. Sc. (Poultry Production), Cairo University, 1999

M.Sc. Agric. Sc. (Animal Nutrition), Cairo University, 2006

A Thesis Submitted in Partial Fulfillment

Of

The Requirements for the Degree of

DOCTOR OF PHILOSOPHY

in

Agricultural Sciences

(Poultry Physiology)

Department of Poultry Production

Faculty of Agriculture

Ain Shams University

2018

Approval Sheet

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ABSTRACT

Yasmein Zein El Abdeen Abd El Ghaffar: Effect of some Environmental Factors on Immunity Measurements and Their Gene Expression in Rabbits. Unpublished Ph.D. Thesis, Department of Poultry Production, Faculty of Agriculture, Ain Shams University, 2018.

This study aimed to study the effect of season and age and their interaction on productive traits, oxidative profile, metabolic rate and immunity parameters as response to “*Pasteurella*” vaccine. Study was carried out in Sakha Breeding Station (Kafr El sheikh Governorate), Animal Production Research Institute, Agricultural Research Center, Ministry of Agriculture, Egypt. This work continued for four seasons; Autumn, Winter, Spring and Summer. Also, immunity parameters studied as response to “*Pasteurella*” vaccine during four seasons in 20 rabbits each season. Twenty rabbits divided 2 groups first group; rabbits injected by vaccine (*Pasteurella*) at 8 and 10 weeks of age, in second group rabbits injected by saline at same ages. In each season 15 rabbits were sacrificed from 2 groups at 8, 10 and 12 weeks to take the spleen for assaying the gene expression. Our results showed the analyses of individual bunny weights in winter are higher than other season. Average daily gain and daily feed intake from the 6th to 12th week were 23.7 and 85.9, respectively. The period of the year is heat stress has adversely effects on the daily gain and daily feed intake from the 6 to 12 weeks and was significant ($p < 0.05$). Hydrogen Peroxide was significantly affected by season while Malondialdehyde and glutathione S-transferase (GST) was not different significantly. Mean plasma glucose concentrations were not significantly different as affected by season. Triglycerides were higher ($P < 0.05$) in rabbits during summer. From summer to spring season, urea values gradually significant increase in rabbits. Vaccination with *Pasteurella multocida* (P.m.) led to an increase in gene expression for Interleukin-6 (IL-6) an up regulation (1.0 to 0.78 fold) of compared to the

uninfected (UI) control in autumn and winter while expression for IL-6 in spring was lowest the values (0.42 fold) . Gene expression of toll-like receptor-4 (TLR-4) in rabbits under different seasons had not significantly different. (ELISA) was affected significantly by interaction of season and age in rabbits treated by Pasteurella. Antibodies for Pasteurella assayed by ELISA technique and were significantly different between winter and spring. Also, the results stated that increasing HI log titers were significantly association with advance of age in winter season, only. It is summarized that winter and spring had a positive effect on body weight, daily gain (g) and feed intakes. Gene expression of toll-like receptor-4 (TLR-4) in rabbits under different seasons had not significantly different. Vaccination with Pasteurella led to an increase in expression for interleukin-6 in autumn and winter. It is suggested to use additives for enhancing immunity during summer and spring.

Keywords: Rabbit, season, Gene expression, Immunity, Metabolic changes, Growth

ACKNOWLEDGMENT

First of all thanks are due to our merciful "ALLAH" for his continuous help through my study and my life.

I have the pleasure to express my deepest appreciation and sincere gratitude to **Prof. Dr. Ibrahim El-Wardany El-Sayed**, Professor of Poultry Physiology, Department of Poultry Production, Faculty of Agriculture, Ain Shams University; for suggesting and planning the work, close and kind supervision, valuable advice, revision of the manuscript and continuous help.

My deep gratitude is extended to **Prof. Dr. El-Sayed Abdel-Kafy**, Animal Production Research Institute, Agriculture Research Center; for suggesting and planning the work, supervision, providing facilities, excellent guidance, revision of the manuscript and continuous help.

My deep gratitude is extended to **Dr. Marwa Shaban Sayed**, Lectural of Poultry Physiology, Department of Poultry Production, Faculty of Agriculture, Ain Shams for his close and kind supervision, valuable efforts and advices .

My deep gratitude is extended to **Prof. Dr. Samah Fikry Mohamed Ali Darwish** Professor of Biotechnology, Animal Reproduction Research Institute, Ministry of Agriculture for supervision, providing facilities excellent guidance, revision of the manuscript and continuous help.

My deepest thanks to **Prof. Dr. Ahmed Farid**, Researcher, Animal Production Research Institute, Agriculture Research Center, for his valuable advices and continuous help and encouragement.

My special thanks and deep appreciation are extended to my beloved parents and brothers and all my friends for their credible encouragement.

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INTRODUCTION

Rabbits (*Oryctolagus cuniculus*) have several characteristics that would make them particularly suitable as meat-producing animals, especially when compared with other herbivorous animals. Rabbits could contribute significantly to solving the problem of meat shortage (**Lebas, 1982**). The meat of rabbits has a low cholesterol level, high protein/energy ratio and is relatively rich in essential fatty acids. Recent years, domestic rabbits have been considered as a good alternative source of animal protein for the increasing human populations in developing countries (**Lukefahr and Cheeke, 1990**). The rabbit industry in Egypt does not widely spread as that for broiler or egg production industries. Consumers still prefer red meat and broilers, which affect consumption of rabbit meat. The local demand for rabbit meat is dependent on the small flock holders and farmers. They usually experience high rate of mortality and low level performance of the local rabbits (**Abd El-Halim, 2003**). It is well known that rabbits are very sensitive to extreme environmental conditions, particularly temperature. Rabbits exposed to ambient temperature of 25 °C for 12 hours daily had lower weight gains than those kept at 15 °C. Environmental temperatures above 28 °C cause heat-induced physiological stress. Thermoregulation in rabbits is rather poor as they have few functional sweat glands (**Naqvi et al., 1995**). Seasonal variations in temperature, rainfall and resource availability are ubiquitous and can exert strong pressures on population dynamics. Infectious diseases provide some of the best-studied examples of the role of seasonality in shaping population fluctuations. Several studies were carried out to investigate the productive potentialities of native and exotic breeds of rabbits under the Egyptian condition, but till now there is a need to obtain more information about the genetic, environmental and managerial aspects of rabbit production to create a profitable industry especially under high temperature condition (**Frenandez-Carmona and Cervera, 2010**). High environmental temperature, as encountered in

Egypt and in many other countries during summer season causes negative impacts in performance and immunity of rabbits and represent a major constraint factor for rabbit production (**Askar and Ismail, 2012**). Therefore, the aim of the present study was to evaluate the effect of season and age on production traits, metabolic and oxidative profile parameters, immunity indicators and their gene expression, along with leptin hormone concentration in growing rabbits reared under different seasons of the year.

REVIEW OF LITERATURE

1. Effect of seasons

1.1. Effect of seasons on production traits:

In intensive rabbitries, there is try to reduce the effect of the season by optimization of environmental conditions like temperature, humidity, ventilation and lighting regime. In spite of the regulation of environmental conditions in rabbit houses season plays a significant role in relation to growth and reproduction of rabbits. Rabbit are very sensitive to heat stress, which could be an important factor influencing their growth and fertility. Exposure of growing rabbits to heat stress during summer adversely affects their growth and reduces the resistance to sicknesses and increases post weaning mortality (**Marai *et al.*, 2002**). In addition, it has a negative effect on the rabbits growth rate , average daily gain and feed efficiency(**Ayyat *et al.*, 2004, Villalobos *et al.*, 2008**) leading to major production losses. **EL-Sheikh (2001)** revealed that while live body weight, weight gain and feed intake of 35-day-old NZW rabbits were significantly ($P<0.001$) decreased, a better feed conversion ratio, when rabbits were introduced to summer heat stress conditions compared with their control group. While adjusted carcass, liver, kidneys and all carcasses weights insignificantly differed. **McNitt and Lukefahr (1993)** reported a significant impact of the season on the growth of rabbits, with the lowest gain in summer. Also **Marai *et al.* (2001)** found that daily weight gain and feed intake of growing rabbits declined with heat stress. **Ismail(1999)** who conducted a study on growing NZW rabbits, showed that raising the ambient temperature, regardless the studied protein levels, from 18-20°C to 29-33°C cause a significant ($P<0.05$) reduction in final body weight, body gain, and feed intake, but improved feed conversion ratio ($P<0.05$). Digestibility of nutrients and slaughtering traits were also affected by the ambient temperature, being better in rabbits kept under the higher temperature. **Habeeb *et al.*(1993)** found that imposing 5-week male Californian rabbits to high temperature ($35\pm2^{\circ}\text{C}$) for 6 hrs daily,

significantly ($P<0.01$) decreased body weight, daily gain, feed intake and efficiently, while significantly ($P<0.01$) increased rectal temperature as compared with their equivalents kept under natural winter season temperature ($20\pm 2^{\circ}\text{C}$). **Marai *et al.* (1994a)** confirmed a heat stress ($34.2\text{-}38.4^{\circ}\text{C}$) depressing effect on rabbits performance, while they found that 60-days growing female NZW rabbits were significant ($P<0.05$) lowered live body weight, daily body gain, dry matter intake compared with that recorded with the control winter group ($16.4\text{-}20.3^{\circ}\text{C}$).

Exploring the effect of summer heat stress on 4 NZW and 4 californian 5-week male rabbits, **Marai *et al.* (1994b)** reported that heat stressed ($33.8\pm 1.0^{\circ}\text{C}$) rabbits and a significant ($P<0.01$) lower body gain, feed intake compared with those raised during the winter season ($19.2\pm 2.6^{\circ}\text{C}$), water intake was increased significant ($P<0.01$) due to the summer season. Under Italian condition, **Chieric to *et al.* (1995)** obtained lower ($P<0.01$) final body weight, daily gain, and feed intake for 5-week male Girmaud rabbits reared under 27°C compared with their counterparts raised at 20°C (thermic neutrality temperature). Furthermore, exposure to natural summer hot (29.7°C) conditions decreased live body weight (16.0%, $P<0.01$), body weight gain (26.5%, $P<0.05$), average feed intake (20.0%), feed cost, return from body gain and final margin, also, it decreased carcass weight, head, liver and dressing percentage of 35-day old NEW rabbits as compared with winter raised counterparts as reported by (**Ayyat and Maria, 1997**).

In a series of studies, **Abdel-Monem (1999)** confirmed the deleterious effect of summer (June-Aguset) upon performance when compared with winter (November-January) season. Summer season resulted in a significant decrease ($P<0.01$) in final live weight and daily gain, also markedly decreased daily feed intake, and return from body gain of summer-5-week old grown rabbits compared to those belonged to winter treatments. **El-Aasar (2002)** reported that summer season conditions lowered final body weight (8.7%), weight gain (11.5%) and

daily feed intake (8.6%) of 5-weeks old raised male rabbits compared with their relatives raised during winter season. **Okab *et al.* (2008)** compared to NZW rabbits performance during spring and summer seasons in natural condition. The maximum and minimum ambient temperature were 27.1°C and 18.9 °C in spring versus 32.2°C and 26.5°C in summer, while the average relative humidity was 86.1% in spring versus 89.5% in summer. Results showed a decrease in body weight during summer, which was accompanied by decreases in feed intake and increase in water intake. In the warm season, there was a reduction in feed intake and an improvement in feed efficiency. Along time, however, the mean body weight of does was similar in the two seasons (**Teixeira *et al.*, 2013**).

1.2. Effect of seasons on metabolic parameters:

The biochemical composition of blood plasma reflects the metabolic status of tissues and organs, and is largely used by physicians to assess tissue injuries, disorders in the functioning of specific tissues and organs and metabolic imbalances. The interpretation of the blood biochemical profile is complex due to the several mechanisms that control the blood level of various metabolites, and laboratory biochemical assays are commonly performed for detection of abnormalities (**Cordova *et al.*, 2009**). These include assays for detection of circulating lipid components such as cholesterol, triglycerides, glucose and glycated hemoglobin, among other markers that are used to detect metabolic syndrome, together with interrelated risk factors of metabolic origin (**Stone *et al.*, 2013**).

High environmental temperature induces physiological stress in rabbits leading to production losses, also because of their quite poor thermoregulation ability. Some consequences of heat stress affect digestive system functions, with impaired appetite, growth and feed conversion, but also with increased disease incidence. These effects can also reflect on the levels of some blood metabolites. Relatively few experimental works are available on the effects of high environmental